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Hospital Construction,

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WITH NOTICES OF

FOREIGN MILITARY HOSPITALS.

BY CHARLES A. LEE, M. D.

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HOSPITAL CONSTRUCTION.

In every civilized portion of the globe, hospitals have been deemed a public necessity, and in modern times, immense sums have been expended for their construction and support. It may be truly said that they are in some measure the criteria of a nation's progress in civilization, and the measure of its cultivation of those charities which spring from the heart of a people imbued with philanthropic sentiments. And yet no institutions have been so abused and mismanaged as public hospitals. Originating in the purest benevolence, and supported with the most commendable liberality, they have, from faults of site, construction and management, not only in a great measure failed in accomplishing the objects in view, viz., the recovery of the largest number of sick men in the shortest possible time, but they have even aggravated the very evils they were designed to remove. The laws of sanitary science, imperfectly understood, it is true, until comparatively modern times, have been, for the most part, disregarded and ignored by those who have had these institutions especially in charge, until at length it became a serious question, whether it would not prove a blessing to mankind if they were not abolished altogether. Such was the conclusion very generally arrived at by our military surgeons towards the close of the Revolutionary war, when Dr. Rush used the following language :

"Hospitals are the sinks of human life in an army. They robbed the United States of more citizens than the sword. Humanity, economy and philosophy, all concur in giving a preference to the conveniences and wholesome air of private houses, and should war continue to be the absurd and unchristian mode of deciding national disputes, it is to be hoped that the progress of science will so far mitigate one of its greatest calamities, as to produce an abolition of hospitals, for acute diseases," (*Med. Inquiries* vol. 1, p. 150.) And yet the same writer remarks on the same page, that "hospitals built of coarse logs, with *ground floors*, with fire places in the middle of them, and a hole in the roof for the discharge of smoke, were found to be very conducive to the recovery of the soldiers from the hospital fever." It is very remarkable it did not

occur to so sound a thinker as Dr. Rush to inquire whether the evils attending our military hospitals at that period were not owing to unhealthy sites, wrong construction, overcrowding and bad ventilation, causes not difficult, perhaps, to avoid or remove, rather than necessarily incidental to all hospitals.

And so, also, Dr. Jackson, in his "Remarks on the Constitution of the Medical Department of the British Army," p. 340, observes that "it is proved in innumerable instances, that sick men recover health sooner and better in sheds, huts and barns, exposed occasionally to wind, and sometimes to rain, than in the most superb hospitals in Europe." That he appreciated, however, the principal cause is evident from another remark, viz: That "it was often proved in the history of the late war, that more human life was destroyed by accumulating sick in low and ill-ventilated apartments, than in having them exposed in severe and inclement weather, at the side of a hedge or common dike."

But notwithstanding it was generally acknowledged that military and naval hospitals were most unpropitious to the health of their inmates, no rational inquiries were set on foot to ascertain the causes or degree of this unhealthfulness, until 1860, when a royal commission was appointed by the British Parliament to inquire into the sanitary state of the army. This commission, having ascertained that the annual deaths in the army at home stations, reached the height of 17.5 per 1000, whereas the mortality among males of the same ages, in the town and country population of England and Wales, was, at the same time, only 9.2 per 1,000, little more than one-half; another commission was appointed for "improving the sanitary condition of barracks and hospitals;" to defects in which the excessive mortality had been distinctly traced.

This commission was commanded to examine and inquire into the sanitary condition of all barracks and military hospitals in the United Kingdom, as regards their position, neighborhood, construction, drainage, water supply, lavatories, laundries, baths, kitchens, water-closets, latrine arrangements, urinals, means of ventilation, lighting and warming, both by day and by night, the dimensions of the barrack-rooms and sick-wards, the arrangements of and the distance between the beds, the supply of bedding and utensils, the amount of cubic space per bed in barracks and hospitals, the state of repairs of the buildings, the condition as to cleanliness of wards, barrack-rooms and other buildings, and of their vicinity, and into all other matters connected with the buildings which may be prejudicial to the health of the soldiers. Besides all this, it was made the duty of the commission to devise the necessary works and mea-

asures required for removing defects in the drainage, for improvements in water-closets, latrines, and urinals, for providing lavatories, baths and laundries, for thoroughly and efficiently ventilating all barrack-rooms, rooms, wards, day rooms, for warming and lighting by day and night, and for improving the kitchens in all barracks and hospitals.

I may remark here that the great mortality in the British army was not more owing, perhaps, to hospital defects than to abuses connected with barrack life; the foul air of over-crowded sleeping rooms and guard rooms, bad drainage, cess-pits and ash-pits, and manure-pits, occasioning nuisances, and polluting the water, bad cooking, want of bathing accommodations, &c.

Still, the sanitary condition of hospitals was found as bad, if not worse, than that of the barracks. Many of those were found to occupy sites either naturally unfavorable to health, or which had become unhealthy from causes which might have been prevented. In many instances, the area of ground devoted to the hospital was too small to afford sufficient space for offices, and for an exercising ground for convalescents. In general, the hospitals had been built without any uniform plan; there was no adequate recognition of the influence of one form of construction more than another on the ventilation, lighting and sanitary state of the buildings—the wards were often placed back to back, with no sufficient means of thorough ventilation—long passages or corridors were introduced, into which a number of wards opened, whereby the foul air of all the wards became diffused through the building, and direct light and ventilation were cut off from one entire side of each ward—there was moreover deficiency of window space—there were only windows on one side of a ward—they were also placed at opposite ends of the wards, with the beds arranged in consequence along the dead walls, instead of between the windows—the distance between opposite windows was also too great to admit of the ward being properly lighted or ventilated—the height of the wards was too small—and in some hospitals, there was an unnecessary multiplication of parts, by which the original cost of the building was enhanced, the space cut up into an unnecessary number of wards and offices, the cost of administration increased, and the sanitary state of the building injured—there was also much overcrowding in nearly all hospital wards, great diversity in the amount of cubic space allowed for the sick, and the absence of any recognized principles as to the amount of space per bed necessary for the healthfulness of the building. Of 114 hospitals, examined with reference to their sanitary condition, it was found that there

were no proper arrangements for ventilation in any, except one in Dublin; that the atmosphere in sick wards was close and stagnant; the wards all overcrowded, with no attempt at ventilation, either of stairs, passages or store-rooms—that the means of warming were defective, and no combination of warming with ventilating arrangements. They also reported the surface drainage defective in many cases, the gutters imperfectly laid and retaining foul water; no drainage of the water closets in most instances, but only cess pits, often close to the hospital walls, and full to overflowing with foul water, or their fluid contents infiltrating the sub-soil, and endangering the purity of the hospital wells. Where water closets existed, they were of defective construction and liable to be out of order; often without sufficient ventilation, or sufficiently cut off from the hospital itself; privies in the hospital yard placed over cess-pits, or emptying into ash-pits; the water supply often deficient in amount, and in a majority of cases obtained from shallow wells, and distributed by hand labor; ash-pits in general use for receiving hospital refuse, and often situated in close back yards, and in immediate proximity to the sick wards. For the most part there were no ablution accommodations suitable for sick or convalescents; few, or no fixed baths, properly supplied with hot and cold water; no proper bath-rooms; all the arrangements totally inadequate for their objects. Hospital kitchens were usually within the hospital buildings, under sick wards, and without ventilation. Cooking ranges were in a state of ill repair or worn out, and no uniformity in the means of cooking hospital diets; no means for washing and drying minor articles, such as towels, dressings, &c., used for the sick; hospital storage both defective and deficient; surgeries deficient in space; no orderlies' rooms, and orderlies' sleeping among the sick. To sum up, the commission report that out of the entire number of 7,167 beds appropriated to sick soldiers, they found only 264 that had anything like a proper amount of space; the numbers standing thus: 362 under 400 cubic feet; 959, 400 and under 500; 820, 500 and under 600; 1,927, 600 and under 700; 1,707, 700 and under 800; 705, 800 and under 900; 423, 900 and under 1,000; 240, 1,000 and under 1,100; 18, 1,100 and under 1,200; 6, over 1,200 cubic feet.

Soon after arriving in London, in May last, I formed the acquaintance of Dr. Gibson, the head of the Medical Bureau of the British army, and Capt. John Galton, of the Royal Engineers, one of the members of the commission, from whose able report, in 1861, I have so freely drawn. They very cheerfully aided me in my examination of the army barracks, as well as the army and naval hospitals,

and furnished me every facility I could desire in pursuing my investigations. To Capt. Galton, especially, am I indebted, for his kindness in furnishing me, for the use of our government, lithographic plans and working drawings for the construction of regimental hospitals for 60 and 120 beds, with full details, specifications and drawings for every part. Also, a circular memorandum for the guidance of commanding Royal Engineers, in the erection of regimental hospitals, and similar plans and details of the new military hospital at Netley, near Southampton, containing over 1,000 beds. I notice these and other similar kindnesses and civilities extended to me in England, with the greater satisfaction, inasmuch as they serve to lighten the shadow which other events and occurrences projected across my path, during a three months' sojourn in London.

It is well known that this commission not only effected many most important reforms in the existing barracks and military hospitals of Great Britain, but that it has brought about, also, a complete change in hospital construction, ventilation and management. When they commenced their labors, the general hospital at Dublin, and the Fort Pitt general hospital, were the only two military hospitals in the United Kingdom in which the pavilion structure had been followed, (the latter very defective, inasmuch as the windows were at the ends instead of the sides of the walls); now, the pavilion or block plan, is the only one recognized, as suited for hospital purposes, whether general, regimental, or camp or temporary hospitals. The objections to large general hospitals are, that it is very difficult to preserve in them that degree of purity, in the air around the sick, that is essential to speedy recovery—that in a large, complicated building, as general hospitals usually are in Great Britain, the air is sluggish in its movements at all times, and always charged more or less injuriously with miasm from the sick—that a hospital or infected atmosphere is very apt to be generated, while in still, close weather the air of a large hospital may become absolutely pestilential, giving rise to malignant fevers, erysipelas pyæmia, hospital gangrene, &c. Besides every slight neglect of cleanliness, and foul air from nuisances outside, from sewers, or other similar sources of atmospheric impurity, become of serious importance to the state of the air in the building. So true is this, in regard to the great London hospitals, that the patients are in less advantageous circumstances for recovery at the present time than they were in the times of Cheselden and Pott, when it was a comparatively rare thing for their great operations to be followed by pyæmia and hospital gangrene. We know that epidemics of these fatal diseases may now and then break out in their wards, attacking

every open wound ; that erysipelas is scarcely ever absent, and persons suffering from the slightest wound are as liable to be thus sacrificed as those on whom capital operations have been performed. In May and June last, I found an epidemic of hospital gangrene making great ravages in the University College hospital, St. Bartholomew's, and several other of the metropolitan hospitals, in London, while it seemed to be considered by the surgeons as an unavoidable occurrence, due rather to an outside atmosphere, loaded with effluvia from the living and healthy organisms of a dense population, than the confined and unhealthy air of the wards. And so of the large Parisian hospitals, where more than 50 per cent. die after thigh amputations, the result of erysipelas, phlebitis and pyæmia,—all modifications of hospital poison, and which may truly be said to prevail epidemically in these establishments. I shall not stop here to prove that these evils are not necessarily incidental to large general hospitals ; this important fact has been abundantly established during our present war, by the extraordinary, if not total absence of all such affections in some of our largest military hospitals, as at Point Lookout and Hampton, each sufficient for the accommodation of 2,000 patients.

I do not design to enter into details in regard to the faults of construction, &c., in the old established military hospitals in Great Britain, as they are sufficiently pointed out in the report to which I have already alluded. I will, however, briefly refer to two, as specimens of many others which I visited. These are the Chatham Garrison Hospital and the Fort Pitt General Hospital, both at Chatham, and both constructed on the same plan. The first, which is said to have been the original model, on which the plans of all the more recent defective hospitals have been framed, consists of a basement and three complete floors of wards above, with a fourth floor or story, containing five back to back wards at the top of the staircase. The building is 310 feet in length, and of three stories ; there is a corridor running the whole length, affording entrance to 10 wards on each flat. There is only one window in each ward to the outer air, and a door into the corridor, in which there is a window opposite each ward door. The distance from this window through the ward, to the ward window, is 40 feet. Including the upper story, there are 35 wards, so called, or rather dark cells, communicating with each other through the corridors and staircases, which are a common receptacle for the foul air of the whole building. The wards might accommodate 390 sick, but a much larger number has generally been crowded into them. I have never seen a worse plan for a hospital, or one better calculated to defeat the

objects which are always to be held in view, in the erection of such structures. The third story had five wards at the top of the staircase, back to back, with only a single window each; ventilation and light were both impossible.

One of the best planned of the older British military hospitals is that of the "Royal Military Infirmary" at Dublin. I visited this several years ago, when, it struck me then, as one of the best I had anywhere seen. This consists of a centre and two projecting wings; each wing containing three plots of wards, the central part being occupied by the chapel, officers' quarters, orderlies' rooms, &c. There are two wards on each floor of each wing, and these wards are separated from each other by a stair extending from top to bottom of the building. This is, in fact, a pavilion hospital, each wing being a separate pavilion, having its ventilation distinct from that of the opposite one, with which it has scarcely more connection than if it were a separate building. Each pavilion has 6 wards, three large and three small; the larger having windows on opposite sides, and the smaller, windows on three sides, thus exposing all the wards freely to sunlight and air. There are other British military hospitals on the pavilion plan, as that at Stoke Devon, but entirely spoiled by the plan of the pavilions themselves. There are separate pavilions, connected by a one story open arcade or corridor, running along its ground floor, with a terrace above, on which there is access to the open air from the first floors of all the pavilions. But then each pavilion is double the width it ought to be, and then split longitudinally from floor to roof, by a staircase, on each side of which the wards are placed, so that the whole ward wall next the staircase is blank, and has no windows; thus preventing any cross ventilation or thorough lighting.

Before proceeding to speak of military hospitals on the Continent, let us briefly review the principles of permanent hospital construction, as they are at present understood and carried out in Great Britain and its dependencies. The commission has very truly stated that the great points to be secured are, purity of the external atmosphere, abundance of pure air and sunlight within the building, and facility of administration and of discipline, and that these involve the selection of a healthy site, simplicity of plan and construction, a sufficient number of windows, properly placed, a certain number and arrangement of wards, proper ward proportions, a suitable number of offices, stores, &c., and easy means of communication throughout the building. The grand principle, to which every thing else must be subservient, is *the recovery of the largest number of sick men to health in the shortest possible time.*

SITE.

Military, as well as all other hospitals, should be located on level, porous and dry ground, which does not receive the drainage of any higher ground. Clay soils and retentive soils are objectionable. No hospital should be placed in large cities, where the population is dense. Even city hospitals should be located at a distance. As far as possible they should be isolated from all other dwellings, except those immediately connected with their objects. The site should be free from malaria and all nuisances. There should be nothing to interfere with the free circulation of the air, as woods and forests. There should be ample grounds for exercise, and no possibility of encroachment on any side. All the surroundings should favor rapid convalescence.

CLIMATE.

The local climate should be healthy, which implies pure air, free circulation, no nuisances, no undrained or marshy ground near, no ravines or muddy creeks, and plenty of natural drainage outlets.

PLAN AND CONSTRUCTION.

The principles involved have already been stated. The grand object in view is good, healthy wards. Everything must bend to this. Heretofore this has been sacrificed to other considerations, as means of access, discipline and administration.

WARD UNIT.

The ward, then, must ever be the starting point, and the ward construction and proportions must be based on the number of cubic feet per bed. 1200 cubic feet has been recognized by the highest authorities as the standard allowance. But much must depend on the freedom of ventilation, and the rapidity with which the air is changed. This estimate is based on the supposition that the entire air of a ward is changed once an hour. If it is changed in half that time, then 600 feet would suffice, and if by forced ventilation, the entire air is renovated every 15 minutes, then 300 feet would be sufficient. As such rapidity of change would, however, be incompatible with preserving the wards of a proper temperature in winter, 1200 cubic feet is considered the standard air space. At the present time, *the breadth of the ward* is made the foundation of ward construction, because a certain breadth is essential for the ordinary working of the hospital, as there must be space along the centre for tables. If the ceilings are high in proportion to the width, then the beds will be crowded too close together. We must seek to adopt such proportions as are most likely to unite the conditions

of sufficient surface area and convenience, with as near an approximation as possible to the regulation space per bed. A breadth 9.26 feet, and a height of 14, length 72 feet six inches, will accommodate 20 beds, each bed being three feet wide, and 4 feet, 3 inches apart, with about 1400 cubic feet to each bed.

POSITION OF BEDS.

The beds should always be arranged foot to foot on opposite sides of the wards, with their heads to the walls, and the number should be divisible by four, so as to prevent loss of corner space, and thirty-two should be the maximum number of beds in a ward. One is to be placed in each of the four corners, and the others half on one side, half on the other, are to be ranged, two and two between the windows.

WINDOWS.

These are to equal half the number of beds. The distance between the end wall of the ward and the first window from each corner should be 4 feet 6 inches, and the wall space between every two windows 9 feet. The splay of the windows into the room should be 5 feet 6 inches wide. The windows should extend from within 2 feet 6 inches or 3 feet from the floor to within one foot of the ceiling. In a ward 14 feet high the windows would be from 10 feet to 10 feet 6 inches high.

WARD OFFICES.

Every ward requires for itself, or it must have free access to, the following offices:

1. A nurse's room, so placed that a window in the wall will enable the ward master or nurse to overlook all the beds in the ward from the room.

2. A ward scullery, containing a small grate with an oven, a small table and racks for tea things, a well constructed sink of white glazed earthenware, the drain pipe of which should be trapped and ventilated, if connected directly with the sewer, or it should terminate in the open air at a short distance above a trapped sewer grating or rain-water pipe. Over the sink should be two water taps, one for hot and another for cold water. The scullery is intended for washing, eating and drinking vessels, except such as are washed in the kitchen; for warming drinks, "extras," preparing fomentations, heating hot bricks, filling water bottles, making poultices, &c., and for keeping certain articles of ward equipment by themselves. This scullery should be conveniently placed for the ward, but should not open directly out of it. The orderlies

should have a small table for their meals, and each orderly should be provided with a lock-up safe and small locker for holding food, &c.

In every ward there should be two movable dressers with lock-up drawers, the one for linen, the other for stimulants for the day in one place, another compartment for medicines, another for lint, oil-skins, stock medicines, &c. These dressers should be in the ward, visible to all the patients, never in the scullery, nurse's or ward master's room, and the nurse or ward master should keep the sole keys.

3. Water-closets, one for every ten beds, and under, and one for any number of beds exceeding ten, or any multiple of ten, should be provided. This refers to military hospitals alone, as about one third of their inmates can go outside the building, which is always advisable when it can be done. In the larger class of regimental and all general hospitals, these closets should be placed at the end of the wards furthest from the centre of the building, and in such a position that the external air can play freely round them. They should be cut off from the ward by a separately ventilated lobby. The closets should contain one seat each, with a half door over the entrance. The simplest form of soil-pan should be used, and abundance of water supplied. There should be a white stone-ware urinal, supplied with water. In an adjoining compartment should be placed a white stone-ware sink, shaped and trapped like an ordinary soil-pan, but of larger dimensions, with a large water tap over it, for washing out bed pans, &c. In this compartment should be kept the bed pans, urinals, &c. The room containing these closets should be thoroughly lighted and ventilated, and at night the means of lighting, whether by gas or oil, should be secured by a glass pane, and not accessible from the closet.

4. A bath room containing a fixed bath, with hot and cold water laid on, also an ablution table with sunk basins, and hot and cold water laid on. There should be a hot and cold water tap for supplying a slipper bath, on India rubber wheels. One such bath will be enough for one floor of a hospital, and may be kept in any convenient closet. There should be a small earthen-ware sink at which to wash expectoration cups, basins used for dressings, &c. The bath and ablution room should be so placed as to be easily supplied with hot water. It may be placed at the end of the ward, where the water closets are, or between the scullery and the ward, as may be most convenient. In large hospitals, constructed in separate pavilions, the former position will be, on the whole, best: in smaller hospitals, the bath and ablution table may be placed between the

scullery and the ward. The number of bath and ablution rooms required will depend on the size of the hospital and on its construction. In small hospitals, with small wards, the sick of the different wards may very well resort to the same bath and ablution room.

In hospitals of two stories, one bath and ablution room per flat would be enough. But in general hospitals, with large wards, in separate pavilions, one bath per ward, and an ablution room, would be requisite.

Earthen-ware baths, glazed inside, answer best for hospitals. They are more easily cleaned, and keep the temperature more equal than those of metal. Fixed ablution basins sunk in the table, with discharge pipes and plugs, and hot and cold water pipes over them, are best for hospitals; one basin for 10 patients is enough.

ARRANGEMENT OF WARDS AND WARD OFFICES.

This is shown on a "Plan of a regimental hospital for 120 beds," on a subsequent page.

ADMINISTRATIVE OFFICES.

These are also exhibited on the same plan. We have seen the essential parts of a large hospital to consist of: 1. The wards; 2. Ward orderly's room; 3. Ward scullery; 4. Water closets; 5. Bath and ablution room.

The administrative offices consist of: 1. Surgery; 2. Waiting room; 3. Sergeant's or assistant ward-master's quarter; 4. Orderlies' quarters; 5. Kitchen, cook's quarter, scullery, and provision stores; 6. Stores, including pack store, bedding store, clean linen and utensil stores, fuel store, and small foul linen, and condemned store; 7. Surveyor's or assistant steward's room; 8. Wash house; 9. Dead house; 10. Out-door latrines. The size of these various rooms will, to a certain extent, depend on the size and arrangement of the buildings. In small hospitals, of course, they will not all be required. It is desirable that there should be nothing under one roof, except the sick, and what is absolutely necessary for their treatment, nursing and discipline; everything else should be in other buildings. Small hospitals may be an exception to this rule, as these necessities, although under the same roof, may be detached from the sick wards in such a way as virtually to be under another roof.

In carrying out this principle of subdivision, then, the hospital proper will contain the following parts: 1. Wards; 2. Ward-master's rooms; 3. Rooms for ward orderlies; 4. Sculleries; 5. Water-closets; 6. Bath and ablution rooms. In pavilion general hospitals of the larger class, there should be nothing more than these under the same roof with the sick; but in regimental hospitals, the sur-

gery, waiting room, orderly's room and day room for convalescents, may be placed in the centre of the building.

In the detached buildings should be placed: 1. The kitchen; 2. Stores; 3. Wash-house; 4. Dead house; 5. Other rooms and quarters. In short, everything which the sick have to use themselves, and everything required on an emergency, must be where the sick are; but everything not immediately required by the sick, should be placed at a distance, but within convenient reach. The block plan, then, of all large hospitals, consists of two parts, one for sick, another for offices.

NUMBER OF SICK UNDER ONE ROOF.

It is now generally agreed, as the result of experience, that it is not safe in any hospital, to have much above 100 sick, with the requisite attendants, under one roof, and in warm climates, not over 60 or 70. It is a well known fact in hospital experience, that it is difficult, if not impossible, to keep the air sufficiently pure in buildings where large numbers of sick are congregated together. Other things being equal, the mortality in large hospitals is always greater than in small. Hence, hospital tents and marquees, or small detached tents, with from 10 to 20 beds, have been found the most healthy in practice. Many army surgeons maintain that, except in stormy and inclement weather, the sick do better in the open air, without any tents or protection whatever. The pavilion or block hospital plan, has grown out of the conviction that in spite of all precautions, hospital diseases will prevail where large numbers of the sick are collected together, and especially wounded men. Subdivision, then, is absolutely necessary for safety.

BLOCK PLANS OF DIFFERENT CLASSES OF HOSPITALS.

In Great Britain and most of the European countries, three varieties of military hospitals are recognized in the service, viz: 1. Regimental hospitals; 2. General hospitals; 3. Camp or temporary hospitals. We have already seen that the organization in general hospitals differs essentially from that of the others, inasmuch as the administrative portions require greater extension, though the parts immediately required for the sick are the same in kind in all classes of hospitals. The administrative offices may, however, be in separate buildings, as in some of the general hospitals of the United States army. Our military hospitals, both regimental and general, are mostly temporary, consisting of marquees, tents, huts, board buildings, or any houses or available buildings in the neighborhood. In the latter, alterations, such as the removal of partitions, and throwing many separate apartments into one, are neces-

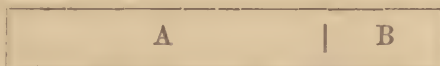
sary to adapt them well for the objects designed. Climate and prevailing winds are also, as already observed, to be taken into account.

BLOCK PLAN OF REGIMENTAL HOSPITALS.

Although permanent regimental hospitals are not, at present, demanded in our country, the time is probably not far distant, when they will be required to a considerable extent: and, in the mean time, attention should be paid to their proper construction. Experience has shown in Great Britain and France, that if the strength of a cavalry regiment be 580, and that of an infantry regiment 1,000 non-commissioned officers and men, the proportion of sick, for whom ward space would be required, would be ten per cent., or from 58 to 100 beds. Making this the basis of our calculations, we may enlarge or diminish the dimensions according as the arrangements of the service may require; always remembering that it is far better to have wards too capacious than not large enough. Whether the arrangements of the service in our army will ever be such as to render any uniform block plan available, is, perhaps, doubtful.

We may safely assume that no regimental hospital should have more than two stories, and that one is better than two, as a general rule. One reason is, that upper stories are always liable to miasma from the floors below, and one flat gives far greater facilities of exit in case of fire.

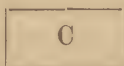
A detachment of 100 men will require, on the above calculation, hospital room for 10 patients, or a single ward with the necessary offices at the end, thus:



A. Ward. B. Administration.

The offices are to be separated from the ward by a lobby or passage running across, ventilated and lighted from above.

In a detachment hospital for from ten to twenty patients, it is recommended to have two wards, with the same block plan, in order to separate the acute and very severe cases from the others; thus:



A A. Large and small wards. B. Administration. C. Detached kitchen.

Where hospital accommodation is required for from 30 to 60 sick, three or four wards are necessary ; one large ward on each side of the offices, which should occupy the central portion of the building, and an additional smaller ward or two carried out at right angles to the main line of the building.

PLAN OF AN INFANTRY REGIMENTAL HOSPITAL FOR 120 SICK.

As late as 1858 there was no good plan of hospital construction in Great Britain. Within the last two years, at least two general hospitals, one at Netley, 1,000 beds, and one at Woolwich, 640 beds, have been erected, also one or more regimental hospitals. The one whose plan is given has been recently erected at Hounslow, and on the recommendation of Capt. Galton I visited it, with a letter of introduction to the architect and superintendent. It consists of one double pavilion containing four wards, each of 28 beds, and four small wards of two beds. The larger wards are open from end to end, so that the attendant in the nurse's room can see every bed in the ward. The small wards have windows on three sides, and are so arranged as to be under constant inspection from the same nurse's room. The water-closets and baths are at the angles of the wards, opposite the entrance, and are entirely cut off from the wards by a method of ventilation which prevents any foul air being blown away from the ward. The large end window allows of easy ventilation during the night. In this hospital the fire-places are in the walls, with a window over them. Each large ward has a separate scullery ; a matter of necessity, not choice.

The two pavilions are cut off from each other by a large passage and staircase traversing the building. The kitchen and stores are under a separate roof. The hospital sergeant and orderlies are quartered in the centre of the building, and surgery and waiting rooms are in the same position, as also a day room for convalescents. Thus the whole administration is concentrated in the middle, and the hospital sergeant can always know at any moment where each of his orderlies is, and where he is not, and what he is doing, and the same of each of his patients. There are no dark corners nor spare rooms, and "skulking" is all but impossible.

This plan, then, combines the greatest facilities for economy in administration with efficiency of discipline, (which includes the utmost care for the sick and the utmost obedience from the convalescent,) and pure air for all.

The wards of this hospital are 14 feet high, and the width between the opposite windows is from 26 feet 6 inches to 26 feet

PLAN OF A REGIMENTAL HOSPITAL FOR 120 PATIENTS.



FIRST FLOOR PLAN



GROUND PLAN

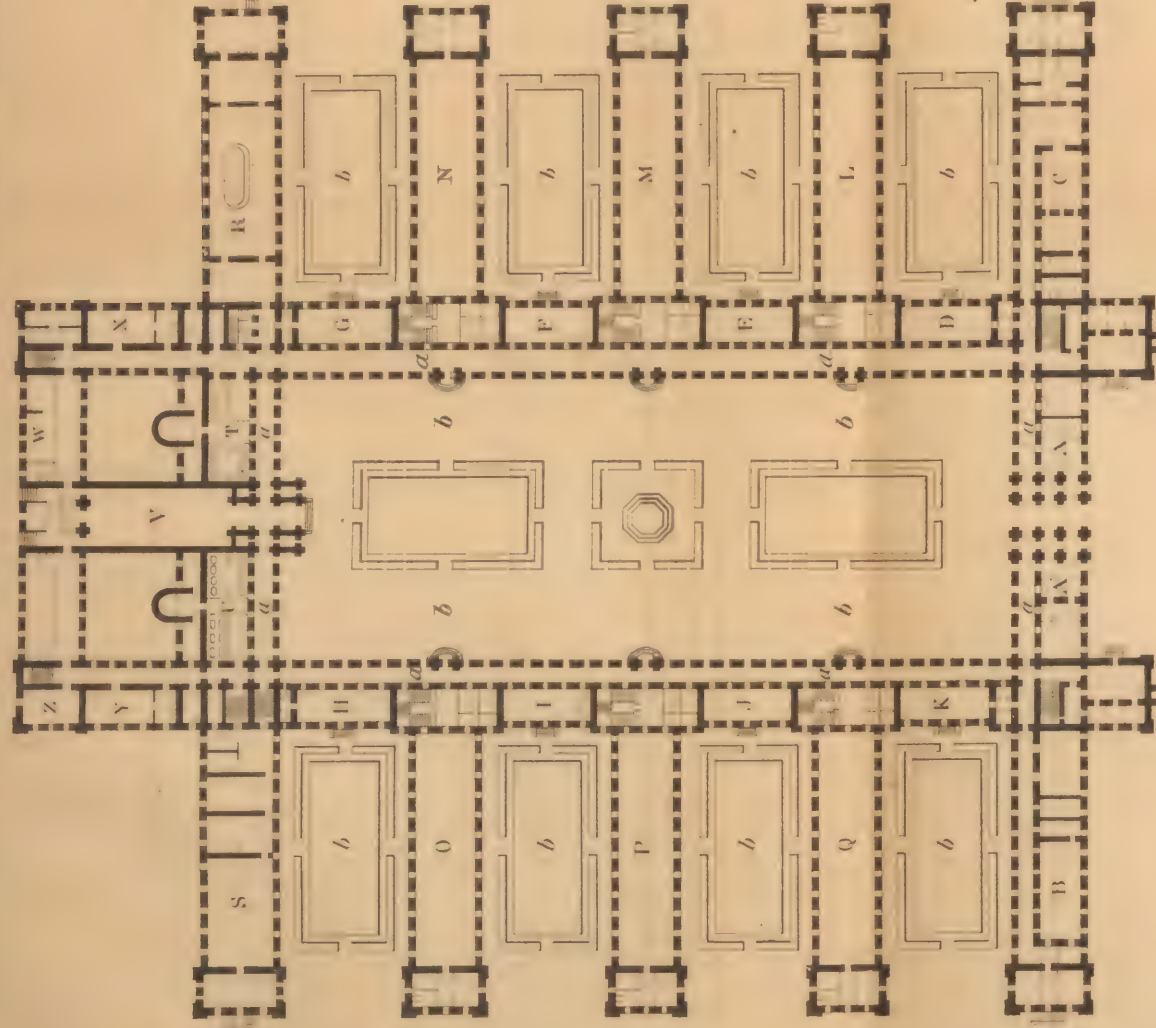
- 11.11. 2 Bed Wards
- 2.2.2.2. Ward Orderlies
- 3.3.3.3. Sculleries
- 4.4. W.C. Sinks & Urinals
- 5.5. W.C. Portable Baths
- 6.6.6.6. Baths, Lavatories & Urinals
- 7.7.7.7. W.C. & Sinks
- 8. Surgery
- 9. Waiting Room
- 10.10. Orderlies
- 11. Day Room
- 12. Hospital Sergeant

- 12^a. Covered Way
- 13 Kitchen
- 14 Scullery
- 15 Medical Comforts
- 16 Larder
- 17 Cook's Room
- 18 Orderlies' Bath & Lavatory
- 19 Utensil Store
- 20 Clean Linen
- 21 Pack Store
- 22 Bedding
- 23 N.C.O.

1st - 1st of 2

W1 (177) 1823

GROUND PLAN OF L'HÔPITAL DE L'ARBOUSIÈRE, PARIS.-312 BEDS.



100 200 300 400 500 FEET

A Doctor's lodge.

B On the ground floor, kitchen, on the 1st floor, lodgings of the officers, on the 2nd floor, dormitories for male attendants.

C On the ground floor, pharmacy; on the 1st floor, lodgings of the officers; on the 2nd floor, rooms of the resident pupils.

DEFGHIJK Dining rooms, 3rd and 4th story high. LMNOPQ Pavilions for sick, three stories high.

R Ground floor, washhouse, on the 1st floor, 2nd floor, dormitories for female attendants.

S Sisters' rooms.

TU Baths.

V Chapel.

W Dead house.

XY operation theatre.

Z a a a a Corridor, one story high, with open terrace above, running round the buildings and connecting them b b b Gardens.

Comstock & Cassidy Albany N. Y.

Deed of Gift 214. 6502

U H 2417, 1763

9 inches. Each bed has from 93 to 97 superficial feet and from 1,200 to 1,400 cubic feet. The cubic space is not as large as that required for civil hospitals, as a larger proportion of the patients are convalescents.*

GENERAL HOSPITAL PLANS.

Many plans have been devised for general military hospitals, perhaps none of them altogether free from objections. The general principles which are to regulate their construction, are: 1. That the block plan is always to be preferred; 2. The pavilions are so to be arranged that the sunlight can fall freely on as large an extent of their surface as possible, and all the surfaces should be freely exposed to the movements of the outer atmosphere. These two requirements prohibit all closed courts, deep closed angles, high adjacent walls, or overshadowing higher ground near at hand, or trees, as being incompatible with healthy hospital construction. The requirement as to sunlight precludes the construction of wards with only a northern exposure, and renders it advisable, as far as practicable, to place the axis of the ward in or near the line of the meridian.

Now there are several block plans which may embody these principles, or fulfill these conditions to a great or less extent. As 1st, where the pavilions are placed parallel to each other, and connected by a corridor, as in the Lariboisiere hospital at Paris, the hospital of St. John at Brussels, the hospital at Bordeaux, &c. Neither of these can be recommended, however, as perfect models. The Lariboisiere hospital has been much extolled as combining more excellencies than any other known plan. Its plan is, no doubt superior to that of any other of the civil hospitals at Paris, but it is by no means suitable for a military hospital. In the first place, it has three stories, or three flats of wards besides the basement. Each flat has a large ward for 32 beds, and a small ward at one end for one or two beds; but this arrangement is unfavorable, both to discipline and to the proper care of the inmates in the smaller wards. The larger wards are 111 feet 6 inches long, and 30 feet wide, affording 104 superficial feet per bed. The ground floor wards are 17 feet 6 inches high; those on the first floor are 16 feet 8 inches high, and the second floor wards are 16 feet 4 inches high. The cubic space per bed is 1,860 feet in each of the ground floor wards. On the first floor it is 1,790 feet, and on the upper floors 1,700 feet per bed. Each ward has 16 win-

* See "Circular Memorandum," at the end of this paper.

dows, 8 on each side; each window being 4 feet 8 inches wide, and extending nearly to the ceiling.

The four corner pavilions contain quarters, administrative offices, medical officers' rooms, dispensaries, Sisters' accommodation, the kitchen, washing establishment, linen stores, &c. The other six pavilions, those in the centre of each side, contain the sick wards. They are all connected by an arched, glazed corridor, one story high, with an open terrace above, passing completely round and connecting the entire buildings. There is a garden, about an acre and a fifth in extent, inclosed within the square, besides gardens between every two pavilions. Each pavilion contains 102 beds. This plan illustrates very well the principle of subdivision and isolation of sick. It consists in reality of six hospitals, connected together, for the purpose of a common administration, in such a way as to admit of the whole building being traversed from point to point with facility.

The area of ground within the inclosure is upwards of 13 acres, or about 2 acres per 100 beds, including the drying ground. There are sufficient means of external ventilation, but the pavilions are only 64 feet apart, which is too little for insuring sufficient sunlight to the wards, as the wards are, to a certain extent, overshadowed by the walls of adjacent pavilions, which are about 55 feet high. No hospital should ever be over two stories high, and in no case should the pavilions be less apart than twice the height of the pavilions themselves.

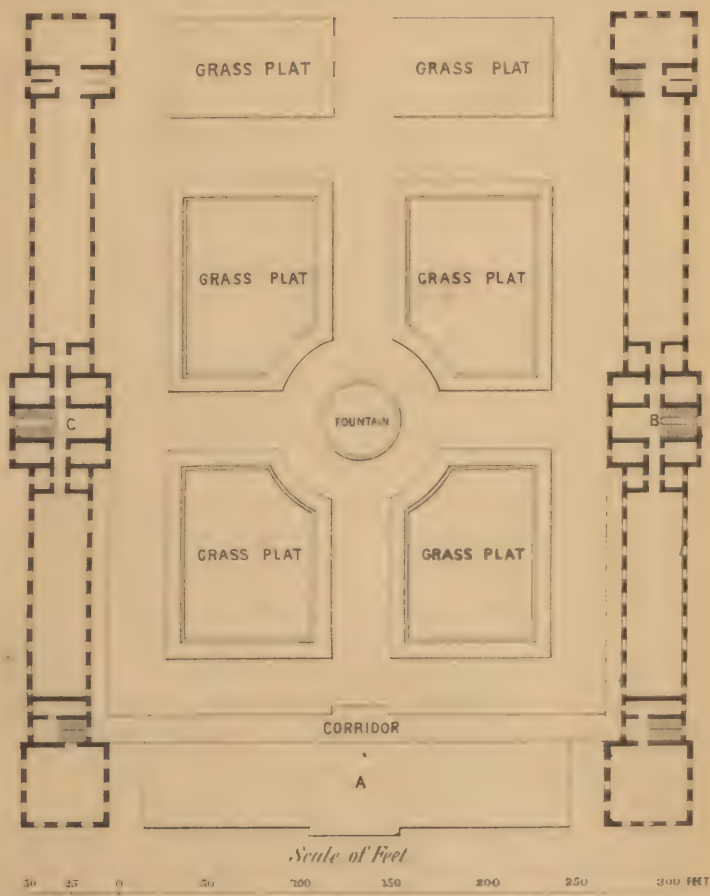
The great advantage of the pavilion plan of construction is, that it admits of great variety in arrangement of the pavilions, and can be adapted to different forms of ground, and can easily be extended by simply increasing the parts, without increasing the cost of alterations. (For ground plan, see annexed plate.)

2. Another block plan is to arrange or rather join the pavilions end to end (instead of arranging them in parallel lines side by side), with a wide, light, well-ventilated staircase between the ends. This plan has been adopted in the new military hospital at Vincennes.

GROUND PLAN OF MILITARY HOSPITAL, VINCENNES.

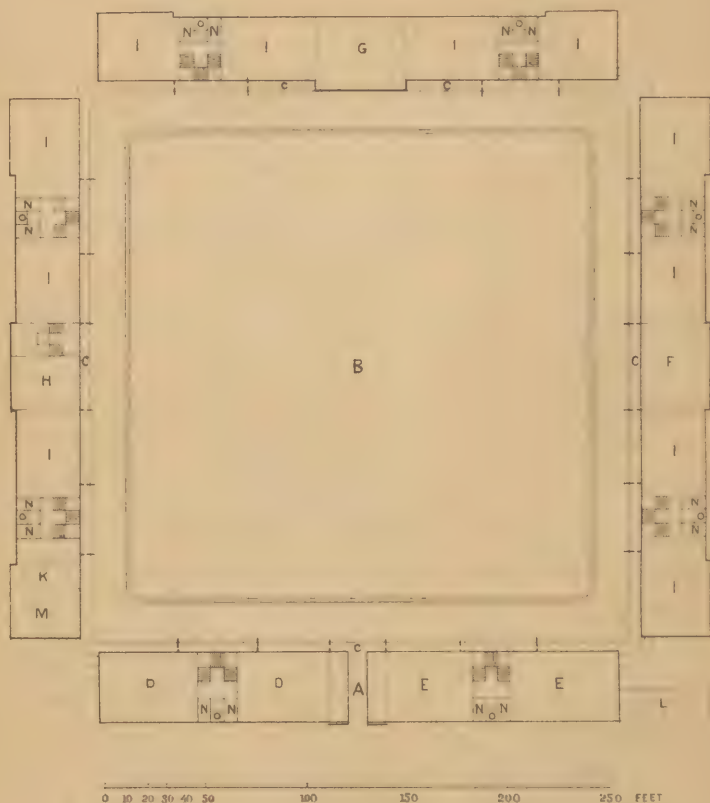
From the accompanying plan it will be seen that there are three pavilions, connected together by an arched corridor passing round the ground floor, to the central entrance of each of the side pavilions. They are arranged to form three sides of a square the fourth side being open to the south. The centre pavilion contains the chapel, offices, quarters, &c., and the two side pavilions, each 340

GROUND PLAN OF MILITARY HOSPITAL, VINCENNES 637 BEDS



- A Offices, guard room, chapel, and apartments for general establishment
- B Kitchen, lunch rooms and accommodation for 15 sisters and 300 soldiers
- C Pharmacy, baths and accommodation for 24 officers and 300 soldiers.

GROUND PLAN OF NAVAL HOSPITAL, YARMOUTH 310 BEDS. *exclusive of Sick Officers' Accommodation.*



- | | |
|--|--------------------------------|
| A Entrance archway. | H Committee room, surgery, &c. |
| B Garden. | III, &c. Wards, 14 beds each. |
| C Open-arched corridor one story high surrounding the garden. | K Padded room. |
| D Rooms for sick officers. | L Bath room, washhouse, &c. |
| E Steward's stores. | MM Sculleries. |
| F Chapel. | NN Nurses' rooms. |
| G First floor, operating theatre, ground floor, billiard room. | OO Waterclosets. |

feet long, contain wards, apothecaries' stores, kitchen, provision stores, &c. The ward pavilions consist of 3 stories and an attic, and are intended to accommodate 616 sick men, and 21 sick officers. The larger wards contain 40 beds each. They are $135\frac{1}{2}$ feet long, by 26 feet 4 inches wide, and give about 90 square feet per bed. The ground floor wards are 15 feet high; those of the first and second floors are 13 feet 7 inches high, which is not sufficient for their length. The cubic space per bed is 1,334 feet on the ground floor, and 1,200 cubic feet on the upper floor wards. There is a window for every two beds. The windows are 9 feet 2 inches, by 5 feet 2 inches.

The attic wards have sloping roofs, and are only intended as a reserve in case of pressure.

The area of exercising grounds inclosed between the pavilions is about $11\frac{3}{4}$ acres, or somewhat less than 2 acres per 100 beds. Where vacant ground is as plenty as at Vincennes, it is difficult to conceive why a hospital should have been constructed, with three stories and an attic. The three floors of Lariboisiere are bad enough. Another objection is, that in bad weather, an officer must traverse the entire length of each pavilion to pass between the opposite extremities of the hospital.

NAVAL HOSPITAL, YARMOUTH.

I notice this hospital here because it has been regarded as the best hospital civil or military in the United Kingdom as regards its block plan. With better internal arrangements, the plan might perhaps be recommended for adoption elsewhere.

The plate shows it to consist of four pavilions, arranged in squares, with their angles open. Each pavilion is 260 feet long, and the whole building is connected by an open arched corridor about 8 feet wide surrounding the inner court. This court is laid out as a garden, and has an area of about $1\frac{3}{4}$ acres. Three pavilions are used for sick men, and the fourth is intended for sick officers and for stores. Each of the three men's pavilions is divided in the middle of its length by a large square block of building not occupied by sick. On one side this space is used as a chapel. On another side it is used as an operating room, and on the third side it contains the surgery, &c. There are thus six divisions for sick men, each of these divisions is again divided up the middle by a large staircase out of which are entered the wards right and left. Between every two wards there are two nurses' rooms and a water closet.

The wards are forty feet long, twenty-three wide, and fourteen

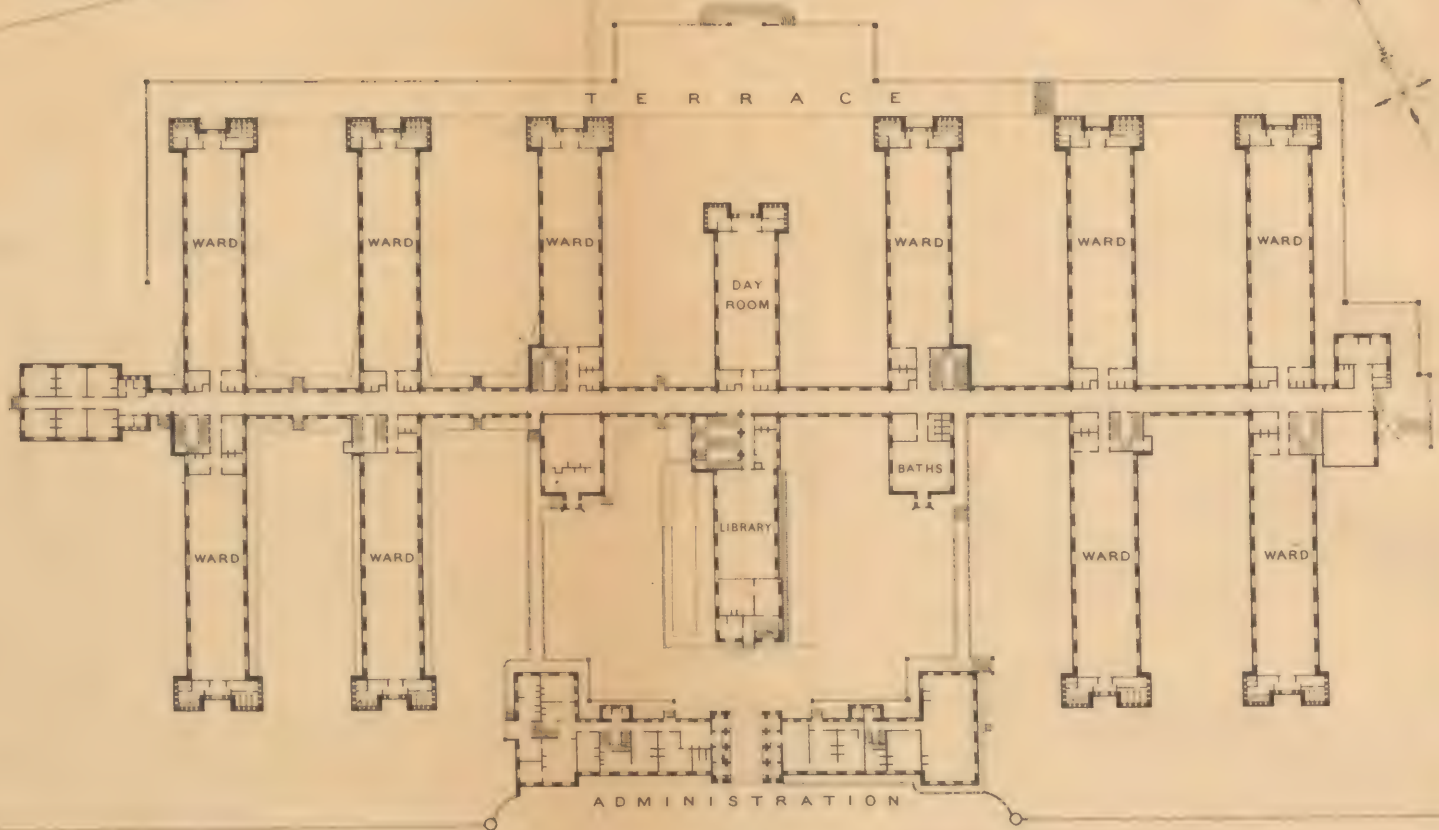
feet 6 inches high, and are intended to occupy fourteen beds. The dimensions give about sixty-six square feet, and nine hundred and fifty-three cubic feet per bed. The windows are on opposite sides of the wards, with the beds between them. The building is two stories high, and the front pavilion, the one devoted to sick officers, is subdivided into rooms of different classes. The men's ward have space for two hundred and forty-two beds at twelve hundred cubic feet per bed. Quarters for the commandant and medical officers, are placed in two houses in the fore court of the hospital. The total area of ground within the inclosure is nine and a half acres. In exposed and windy situations, this mode of arranging the pavilion affords to the convalescent patients an inclosed and protected exercising ground, and enables advantage to be taken of any views of the surrounding country from the ward windows. Whether either of these plans, the Lariboisiere or Vincennes and Yarmouth should be adopted in any given case, will depend on the form and slope of the ground, the exposure, climate, &c. The area of ground required will be about the same in either case, whether the pavilions be parallel and detached, or placed in squares.

Detached parallel pavilions can in most cases be so arranged that their axis will fall in the meridian line, so that they will receive the sunlight on both sides during some part of the day throughout the year; but if built in squares, the axis of the pavilions on two sides of the square only could be so placed. If, however, the open angles of the square were placed towards the four cardinal points, the north wards would be exposed to the sunlight on one side during the whole day in winter, and on both sides in summer, while the south wards would have the sun on both sides during some part of the day both summer and winter.

HERBERT HOSPITAL AT WOOLWICH.

This splendid hospital, embodying most of the modern improvements in construction and ventilation, has been erected during the last two years, and only opened for the reception of patients. The arrangement of the pavilions in this hospital, it will be seen, is different from any of the examples we have given. The number of beds to be provided was 650, and as the ground was not level, the plan adopted had to be modified accordingly. I have nowhere seen a military hospital containing to a greater extent the requisite sanitary conditions with facility of administration and discipline. The illustrated plate will show that the pavilions are double, placed end to end and strung together by a corridor, having a ter-

N E W R O A D



ELLTHAM ROAD

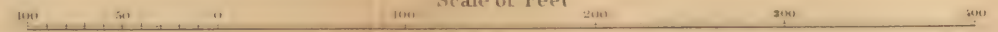
FROM DOVER

D O V E R R O A D

FROM WOOLWICH

GROUND PLAN
OF THE
HERBERT HOSPITAL
ENGLAND.

Scale of Feet



UH 1677, 1813
Tolent after p 20

race above. By this arrangement the same superintendence answers for double the number of beds it would do for in the Lariboisiere hospital. As the whole structure is raised on basements, so as to insulate the wards from the ground, and conforms to the level, advantage is taken of the space so obtained to provide store-rooms and offices of various kinds, which are all connected with a basement corridor running the whole length of the hospital, which is devoted entirely to the carrying service of the hospital. Everything required for the wards, as bedding, clothing, diets, medicines, fuel, &c., is transported on rails to lifts at each pavilion, so as to reach the ward doors without passing by the stairs or corridors used by the sick or their attendants; while all refuse from the wards, such as remains of diets, dirty dishes and utensils, are sent down the lifts, and carried direct to the kitchen scullery. So also dust, cinders and sweepings are sent down separate shoots into closed boxes into the basement corridor, whence they are removed to the end of the pavilion, and discharged once or twice a day into a dust cart.

Each pavilion has also a shoot for foul linen, opening into a small closet in the basement. In the basement of the right hand pavilion, but above the level of the ground, there is a board room, museum, and medical officers' library, with separate entrances. The dead house and post mortem rooms are detached, at the right hand end of the corridor. The first story, or ground floor plan is devoted chiefly to sick wards, of which there are seven, 32-bed wards, and three 28-bed wards. One of them is a prison ward, and has a sentry's room, with access from the outside. There is also a set of lunatic wards at the end of the corridor, as well as a ward for itch cases, with separate baths, and also an operating theatre, and an operation ward attached to it. The library is in the same story over the kitchen, and the day room opposite to it has access at the end by a porch to the exercising grounds. The pharmacy and general baths are on either side of the library.

The second story, or the first floor plan, as it is called, has eight 32-bed wards, two 28-bed wards, one 20-bed ward, and two small wards at the right hand end of the corridor for offensive cases. The chapel is on this floor over the library and kitchen. The communication between the wards is by an open terrace over the corridor, so as not to interrupt the free movement of the air between the pavilions. There are thus only two floors of wards, each ward is fourteen feet high, and the pavilions sixty-four feet apart. The attic contains orderly's sleeping rooms. The building is about 720 feet in length. The axis of the pavilions lie north and south, a little inclined to the east, the ward thus receiving sunlight on both

sides during the day. The outer walls are of white brick, which gives the whole structure a cheerful appearance. The inner walls and ceilings are of polished Parian cement. The wards are heated by two fire-places in the centre of each, made of terra cotta, and so constructed as to give the greatest warmth. The flues are carried under the ward floors, and up the side walls of the pavilions, leaving the view of the ward open from end to end, and enabling the nurse to see every bed from her room window. The head nurses are females.

The principles embodied in this plan are subdivision of sick under a number of separate roofs, separation between the hospital proper and the administration; two floors of wards only; opposite windows in each large ward with the beds ranged between them, one window for every two beds; sufficient isolation and free ventilation of the water closets and baths, which are at the end of each ward; one scullery and one nurse's room for each ward; and placed at the entrance end, so that the attendants, while overlooking the patients, can be themselves overlooked. Each bed has from 93 to 97 superficial feet, and from 1,200 to 1,400 cubic feet. The width of the wards is 26 feet 6 inches, to 26 feet 9 inches.

Small wards should always be provided in general hospitals for cases requiring segregation, as patients affected with offensive sores and ulcerations; many cases arising during fevers, head diseases, or insanity; infectious cases and dangerous operations and accidents. Every ward, of course, must have its separate scullery, bath, water-closet and lavatory, and those for offensive cases must be entirely separate from the others. The bake house, laundry and gas house, as well as the kitchen, should be separate and away from the hospital and not in the direction from whence the prevailing winds blow. All hospital refuse is to be removed daily. I have minute drawings, in plan and sections, illustrating the whole design of these two last hospitals, as well as the working plans presented to me by Capt. Galton, of the War Office in London, which will be filed in the library of the War Department at Washington.

MILITARY HOSPITAL AT ST. PETERSBURG.

I speak of this hospital, as it is regarded by many as one of the best in Europe, and built on a plan which has prevailed in Austria for more than a century, and now adopted generally in Russia, Prussia and Turkey. The main building, which is of brick, is three stories in height, and forms three sides of a square, every ward opening on corridors, extending the whole length of the three interior faces, with windows opening on the court yard. Every ward

has three windows opening on the exterior, and two windows and a door on the corridor, with a communicating door from ward to ward. The corridors are so arranged that they may be subdivided by closing large doors, thus confining the communication to separate staircases, and allowing any one ward to have all its windows and doors open for ventilation, without incommoding the sick in an adjoining one, while the corridors may be thrown open in part or in whole, to like ventilation without subjecting any of the wards to its influence. The wards are arched, and both wards, corridors and all the rooms, even to the water closets, are warmed by Russian stoves. The stoves in the corridors, when the windows and doors are open, are a powerful means of ventilation.

The corridors are 12 feet wide, covered with painted cloth on a brick pavement. The floors of the wards are of hard wood, inlaid in geometrical figures, over the brick arches, and kept high y polished. There are from 18 to 20 patients in each ward, each of whom is provided with a straw paillasse, mattress, sheets, blankets, and two pillows, on an iron framed bedstead, with painted bottom boards laid on a flange of the iron frame. The head frame, above the bottom boards, is filled in with sheet iron, making it close, and preventing the pillows from being displaced. An iron rod rises from the head of the bedstead, on which is a tablet giving the name of the patient, his regiment, company, and regimental number; also the number of the ward, and of the bed of that particular ward; his age, period of service, district and department of country where born, whether married or single, number of days sick before coming to the general hospital, and the special number under which he is received in the hospital; all this is written on a printed form, attached to a small slate or black board. Beneath it, the attending physician writes, daily, the symptoms of the disease, the external or internal remedy prescribed, and also the diet for the day. All hospital ward attendants, stewards, nurses, &c., are thoroughly instructed in their duties, in training schools, before entering on their hospital duties. Of course, there is the utmost system, order and discipline, and every part of the vast establishment, containing 1,800 beds, including 30 for officers, is admirably managed. There are operating rooms, a good library of 1,600 medical works, dead house, chapel, laboratory, dispensary, water-closets, lavatories, bath rooms, (one for each ward, containing three metal bathing tubs and one on wheels, warmed by a Russian stove,) kitchens, with ranges, large boilers and ovens, dumb waiters, steam engine, &c. There are attached to this hospital on medical service, 18 surgeons and 218 soldiers and inferior employees; on public

duty, six officers and superior employees, and 396 soldiers and inferior employees. I give no plan of this hospital, as the description will convey, perhaps, a sufficiently accurate idea of it without.

MILITARY HOSPITAL AT VERONA.

This new Austrian hospital was entirely completed just previous to my visit during the last autumn, but a part of it was open for patients in 1856. Its general plan of wards and corridors is the same as that of St. Petersburg, and in conformity with the hospital at Vienna, and the Austrian hospitals generally. There are 1,400 beds. The building is on four sides of a rectangle, instead of three, as that at St. Petersburg, and the wards, which are arranged in a similar manner, have each 20 beds, with one large window in the centre, opening on the exterior, and a door directly opposite on the corridor; over this door is a large window extending nearly to the ceiling, so that when the windows and doors are open, the direct draft is through the middle of the ward, and not over the patients, who are in beds arranged on each side, heads towards the wall. At night a gas light in the corridor and close to the window over the door, suffices to light the ward, as well as the corridor, and no other light is admitted in the room, except by special order. The rooms are all arched with brick, plastered on the solid wall, and warmed by an iron stove on the centre of one side of the ward. The floors of the wards and corridors are of boards, except on the ground floor, where the latter are paved with stone, on parts that do not communicate with wards, in the latter case being of wood. Each ward has its water closet at the end, besides separate extensive bathing establishments for the use of water and steam, in a variety of ways. For steam bathing, a room is fitted with several bedsteads, one rising above the other in steps like an amphitheatre, with sloping head board, for the comfort of the patient, who is laid in his blanket on one of these wooden platforms or bedsteads, and steamed by the admission of any degree and quantity of steam from the boiler in the adjacent apartment. An adjoining room is fitted up with small apartments or stalls, of sizes suited for men, standing, sitting or reclining, each having pipes and faucets, admitting a shower bath from above, from the side of the apartment, throwing the water horizontally, and a third throwing the water upwards from the floor, to fall gently on the patient, thus giving the means of bathing any particular part of the body. In two large apartments there are no less than 36 marble bathing tubs, with tubes and valves for hot and cold water. These tubs are sunk several inches in the floor, so that the top

remains only one foot above, making entrance and exit easy for the patients.

Another apartment is appropriated for a large boiler set in masonry, for steam and hot water for the bathing rooms; connected with this is an apartment containing a large masonry cistern or reservoir, rising nearly to the ceiling, supplying a head of cold water for the bathing rooms, &c., which is filled with water pumped up from the river Adige close by, by manual labor. All the bathing establishments, storerooms, dispensary, and kitchens on the basement floor are about three feet above the level of the courtyard. One arrangement in this hospital struck me as worthy of imitation: every bed is provided with a board about 14 inches wide and 20 inches long, with edges rising about a quarter of an inch above the surface, answering as a table or waiter on which to place the food, tumbler, fork, spoon, &c. Separate wards are provided for infectious and contagious diseases, also for cases of insanity.

The amputation table is similar to what we sometimes find in our colleges and hospitals, consisting of an iron frame in three equal parts, connected by hinges, admitting of the head or foot being raised or lowered at pleasure to any inclination, from sitting to a horizontal position. The table, also, may be raised or lowered to any required height, by means of an iron elevating screw, and may also be turned on its centre.

The dead-house, which is built of stone with marble floors, arched with brick, and having a tile roof, has apartments for post-mortems. The bodies are laid on inclined planes, side by side; to the head or foot of each and every one is attached a bell-pull communicating with a bell in the guard room, occupied by a guard of four soldiers. This hospital, apart from its faulty plan, is admirably managed, and in most respects is a model establishment. It stands on an elevated site on the high banks of the noble Adige, is a fine specimen of modern masonry, and embodies many recent improvements. In addition to the means of ventilation by the window over the door and sashes of the windows opening on the exterior, there is under this latter a smaller one of two feet square, near the floor, to admit fresh air at the lowest part of the room, and a similar opening of twelve inches square next to the ceiling over the door, for the escape of warm or foul air as it ascends. This latter one is closed by a valve movable at pleasure; the one under the window is closed by a solid shutter.

The above will suffice to give a general view of the military hospitals of Europe, in regard to their plans of construction and

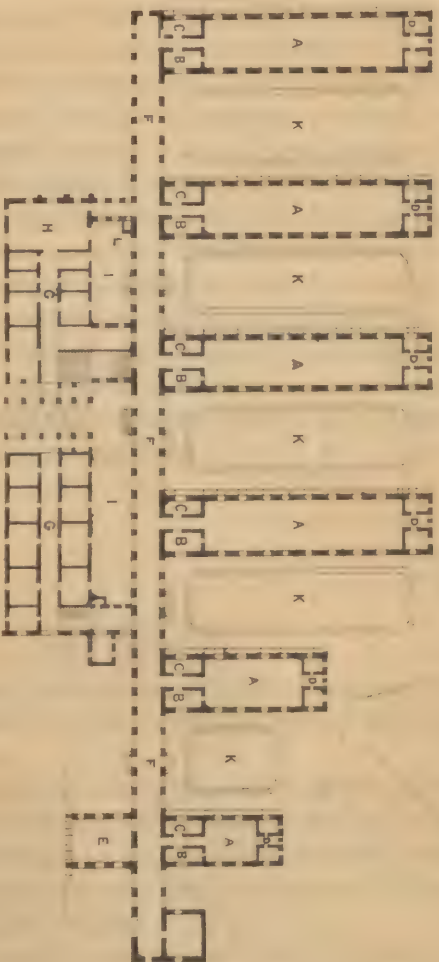
general management. To notice others in detail would be only a repetition of what I have already given. Those of recent construction which I examined in France, Germany, Prussia, Austria, and Italy are generally on the plan of the one at Verona, already described. The Military Hospital at Vienna was built in 1788; the wards open on corridors of eight feet wide, with four windows and a door in the partition wall, and five windows opposite the last openings in the exterior wall, fronting the court-yard. The wards are 60 feet 6 inches long by 21 feet four inches wide, for 25 beds, and have five windows opening on the exterior. All the window sills of the wards are 7 feet above the floors, that beds under them may not be subject to the draft, an arrangement very common in the Italian hospitals. Here hyper-oxide of manganese and sulphuret of iron are extensively used as deodorizers and for purifying offensive vessels. The corridors and staircases are of stone. It seems to have been constructed, though in the last century, on the plan most approved in Europe at the present day.

A new military hospital has recently been constructed at Berlin. It occupies three sides of a square, the main entrance being from the centre and from the court-yard. It contains eight hundred beds, but the wards are small, mostly designed for eleven patients, and some for three or four. All the food in this establishment is cooked by steam. There are no windows between the corridors, and all the ceilings are very low; of course there is no efficient ventilation. The steam-boilers supply power for a steam engine of six-inch cylinder and twelve-inch stroke, which pumps water for bathing purposes to the upper part of the building, and also supplies steam for a Russian bath in a room arranged for the purpose.

The Papal Military Hospital at Rome occupies one of the immense buildings of the San Spirito Civil Hospital. There are accommodations for over 2,000 sick in the whole establishment. The halls or wards are of immense size, and afford space to two rows of beds on each side, leaving still 18 feet in the centre. The ceiling is proportionally high. There are two stories and basement, which is occupied for offices. There is a fine museum here, both of wax as well as natural preparations.

The new military hospital at Genoa, erected by Victor Emanuel, is one of the most splendid and immense establishments of the kind in Europe. Its plan does not differ much from that of the hospital at Verona, and will yield to none in the convenience and excellence of its arrangements. It is beautifully and romantically

GROUND PLAN OF PROPOSED MILITARY GENERAL HOSPITAL, AT MALTA FOR 300 BEDS.



0 50 100 150 200 250 FEET

The dotted line shows the outline of the bastion

- A A Portions, each two stories high, and containing two wards each.
- B B Ward nurses' rooms.
- C C Ward sickrooms.
- D D Water closets, baths, ablution, rooms, and ward sinks.
- E E Operating theatre and two small wards.
- F F Open arched corridor connecting all parts of the hospital

- G G Administration (bapt, governor's principal medical officers and chaplain's quarters, nurses' and superintendent's quarters, captain of orderlies and orderlies' rooms, surgery, waiting room, apothecary, stores, &c.), day room for convalescents.
- H H (convalescent day room, &c. &c. 11 bunks).
- K K Exercising ground.
- L L Laths for ducks

situated on an elevated hill overlooking the city and bay, and commanding one of the finest prospects in Europe.

It is not the design of this paper to treat of the ventilation, heating, drainage, and furniture of hospitals; they are amply discussed in special treatises devoted to these subjects. Nor is it my purpose to speak of temporary hospitals, as tents, marquees, huts, and rough buildings, and their proper arrangement; suitable instructions in regard to these may be found in the report of the Commission on Barracks and Hospitals. My main object has been to speak briefly of some of the more important military hospitals of Europe, showing their leading plans and arrangements, and the general principles which should be recognized and carried out in the erection of similar establishments. I trust it has been made to appear that PAVILION HOSPITALS are the only ones suited for military purposes; combining a greater amount of sunlight and air; more complete separation of classes and sexes; an easy and more economical supervision; more direct communication with every part; better warming and ventilation; greater economy in expense of first cost, as well as subsequent administration; and finally, greater safety and convenience.

APPENDIX.

“Circular Memorandum for the guidance of Commanding Royal Engineers in the erection of Regimental Hospitals.—[From the War Office, London.]”

“The accompanying plans show the arrangements which should be adopted in regimental hospitals containing any number of beds from 28 up to 136, allowing 1,200 cubic feet per bed in temperate climates, and 1,500 cubic feet per bed in tropical climates; and from 85 to 100 square feet per bed.

“The site selected should be airy and well drained, and the ground should, if possible, fall away from the site in every direction. If, however, it be necessary to place the building on a slope, a plateau should be leveled, and a deep drain cut along the side of the plateau near the upper part of the hill so as to intercept and cut off the drainage of the higher ground from the plateau.

“The inclosure should be drained; the drain tiles being laid four feet under the surface, and the drains placed at such distances apart as will keep the surface dry. No drains of any sort should

be allowed to pass under the buildings. The pavement in the inclosure either square sets well laid to turn off the water, or flagging should be adopted. Surface water should be carried to the drains in smooth gutters, the gutters being carefully trapped.

“The inclosure walls should be as open as possible, a dwarf wall with an iron coping surmounted by an iron railing, and entrance gates of iron to be employed wherever practicable. The inclosure should be laid out neatly and planted.

“The building should, if possible, lie north and south, so as to secure the morning and evening sun upon the ward windows.

“The portion of the building containing wards should never exceed two stories in height. The floor ground should be raised at least two feet above the ground, and there should be a circulation of air under all wood floors.

“No sunk basement should be placed under the wards, except to isolate them from the soil. And in that case the basement should be well ventilated and drained, and should not communicate with the wards.

“The walls of the wards should be built hollow for warmth, and when constructed of brick work, the vacuity should not be less than nine inches from the external face, and need not exceed two and a quarter inches in width.

“The ground round the foot of the walls should be flagged, the flags being sloped to throw the surface water every way from the walls. The window openings of all wards should have splayed jambs and soffits, and with a view to economize heat, the windows should be glazed with plate glass at least one-quarter of an inch thick. The walls should be inclosed, floated, and set with fine stuff, and twice lime-whited, and the arrisses run with Portland cement neatly rounded. Walls of wards should be either lime-whited or finished in distemper, a warm salmon color. No staff, or flush beading to be employed, as it may give occasion for the settlement of dust.

“All wards should have ceilings so as to keep the temperature of the wards uniform.

“The best floors are of hard, durable, non-absorbent wood. The doors of the large wards should have glazed panels to allow of the wards being overlooked.

“The large wards are to be warmed by open fire-places made of fire-tile adapted for the admission of warmed air, similar to those manufactured by George Jennings, Holland street, Blackfriars. All other rooms to have the ordinary pattern ventilating grates, as supplied by Messrs Kennard, 63 Upper Thames street, the sizes to

be proportionate to the cubic contents of the several rooms in accordance with the circular.

“Provision must be made in all cases for the admission of fresh air to the backs of the stoves and grates; and this must be effected in internal walls by horizontal flues carried through the thickness of the walls.

“A small circular stove about ten inches in diameter should be fitted in a recess in the internal wall of each of the lobbies adjoining the ward water closets and lavatories, in order to warm them in winter; fresh air should be brought in under these stoves to be warmed and admitted into the lobbies.

“Fresh air is to be admitted close to the ceiling and between every two windows of the main wards through louvered ventilators, which are made to close in damp or severe weather. The other rooms will be provided with one similar ventilator removed as far as possible from the fire-places. The lobbies and ward lavatories and water closets will also have similar inlets for fresh air.

“Foul air will be carried away near the ceiling line either through flues within the thickness of the walls in the case of two story hospitals, or through trunks of wrought deal in buildings of one story only. These flues should be carried up above the roof and terminate in a louvered turret to prevent rain beating down.

“The aggregate area of the flues for each ward or room will be in the proportion of one superficial inch to every 60 cubic feet.

“In large wards of two stories containing 20 or more beds, four flues, one in each corner, are admissible, but in buildings of one floor, two flues or shafts carried up in the end walls and midway between the side walls will give the necessary area. In those cases where two flues are carried up side by side above the roof line, terminating in the same louvered turret, it will be necessary to continue the division either in wood or brick work up to the top of the turret, so as to make each ventilating shaft complete in itself. The lower end of the flue should be terminated with a louvered opening into the ward, with the covers so arranged as to cause any draft to be thrown up towards the ceiling of the ward.

“The flues should also be capable of being easily swept. The lobbies attached to the wards and the water-closets and lavatories should have similar flues for the removal of foul air.

“The lavatories are to be fitted up with white earthen-ware basins, not less than 12 inches diameter, let into a slate slab fitted with lever plugs similar to those used in Macfarland’s basins, and a urinal of white earthen-ware, as made by Jennings.

“The baths will be of fine clay, as made by Messrs. Rufford, five

feet three inches long at top, two feet four inches wide, and one foot eleven inches deep.

“The water-closets are to be Jennings’ double seated valve closets, of white earthen-ware, glazed, the trap and basin being in one piece. The slop sinks adjoining will be made circular, of white glazed earthen-ware, with a W. C. apparatus and trap, and raised two feet six inches above the floor.

“Water should be laid on to a tap placed to facilitate the washing out of pans, and water should be also laid on to the basin for the purpose of flushing.

“All soil pipes and water pipes should be trapped at the entrance to the drains, as well as close to the water closet, sink, urinal or basin, and they should be carried up above the roof, where they should be terminated by a zinc cap placed so as to allow of an opening all round, for the escape of any foul air, which might pass from the drain into the waste or soil pipes.

“Each ward scullery will be provided with a small hot closet, heated from hot water service, for airing the ward linen, and a small range fitted for a three feet opening; a white glazed earthen-ware sink, three feet by two feet, fitted with Tye & Andrews patent galvanized sink trap, with a screwed outlet for the purpose of draining out when necessary, should be placed in each scullery.

“The sinks should be supported on iron brackets or bearers, and in no case bedded on brickwork, or built up solid underneath.

“Shelves should be provided in the scullery for crockery and racks for plates; also hooks for hanging up cups, &c., should be fixed.

“The baths, lavatory, basins and sinks, in surgery and ward sculleries, and the portable bath sink, are to be supplied with hot and cold water. The hot water service will be provided from the kitchen, as described in the specification.

“The water tanks should be placed in situation to be easily cleaned out.

“The kitchen should be supplied with a roasting range, as recently adopted for officers’ messes, with an opening of two feet to two feet six inches wide; also one of the new pattern steel boilers, and also an oven with hot plate.

“The buildings should be lighted by gas, where available, the fittings employed being of the simplest description.

“The wards should be lighted by globular sun-light pendants, as manufactured by Stevens & Son, Southwark Bridge Road, London, the heated air being carried away from the lower wards by a zinc tube within the thickness of the floor and up a vertical shaft in the

wall to above the roof, and from the upper wards vertically, through the roof, the openings being covered with zinc terminals. Large wards, containing 20 to 28 beds, will require three such burners, and small wards one only.

The following tabular statement shows the arrangement of wards for Regimental Hospitals.

ONE FLOOR WARDS.

Number of large wards.	Number of beds.	Total in large wards.	Number of small w'ds.	Number of beds.	Total in small wards.	Total accommodation.
2	12	24	2	2	4	28
2	16	32	2	2	4	36
2	20	40	2	2	4	44
2	24	48	2	2	4	52
2	28	56	2	2	4	60

TWO FLOORS OF WARDS.

4	16	64	4	2	8	72
4	20	80	4	2	8	88
4	24	96	4	2	8	104
4	28	112	4	2	8	120
4	32	128	4	2	8	136

“The following detached buildings should be provided :

“An itch ward only when required, to accommodate from four to ten patients.

“A foul bedding store to contain a minimum of 1,200 cubic feet of space for every 100 beds; a coal store, a wood store and a store for unserviceable articles, are also required.

“The wash house should have three or four fixed tubs, two coppers, from one of which water might be laid on, a drying closet, as made by Messrs. Jeakes, and a room for ironing or mangling.

“The dead house should be lighted from the roof, well ventilated, and provided with a slate table, water-tap, sink and drainage.

“Detached latrines and urinals, for convalescents and orderlies, should be provided.

“It may further be observed, that in hot climates the greatest care should be exercised in selecting a site.

“If on high ground, the floor of the hospital should be carried at least four feet above the ground line, with a free circulation of air underneath.

“If on low ground where malaria prevails, the sick should be placed on the upper floor alone.

“Verandahs should be carried round the building; Venetian blinds provided to the ward windows, and arrangements made for such additional ventilation as may be found necessary, by openings under the eaves and by turrets in the ridge.

"In cold climates, additional thickness of walls, double windows, or extra thickness of plate-glass, or external shutters should be provided; complete control of the ventilation should be afforded, and arrangements made for the protection of water pipes, drains, &c., from frost.

"The annexed specifications and drawings show the detailed arrangements to be adopted.

"DOUGLAS GALTON,

"*Capt. R. E., Assistant I. G. F.*

"May 28, 1862.

"To Professor Charles A. Lee, M. D."

[The *Specifications* above referred to, as well as the "Drawings" representing all the details for the erection of a regimental hospital, are necessarily omitted. These specifications are complete, and refer to the EXCAVATOR and BRICKLAYER, MASON and PAVIOR, CARPENTER and JOINER, SLATER, PLASTERER, SMITH and FOUNDER, PLUMBER, PAINTER and GLAZIER, WATER SUPPLY, and GAS FITTER. The plates, which are of mammoth size, could not be reduced in size, so as to be intelligible or suitable for publication in the Transactions of the Society.]

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